California Department of Transportation
Division of Research, Innovation and System Information

Research Manual

Caltrans Division of Research,
Innovation and System Information

2021 Edition

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California Department of Transportation
Division of Research, Innovation and System Information

Research Manual

This document meets the requirements for the State Planning and Research, Part II Program

Caltrans Division of Research, Innovation and System Information

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I, Dara Wheeler, Chief, Division of Research, Innovation and System Information, California Department of Transportation, do hereby certify that the State complies with all requirements of 23 United States Code (USC) 505 and its implementing regulations with respect to the research, development and technology transfer program. I contemplate no changes in statutes, regulations, or administrative procedures that would affect such compliance.

Dara Wheeler

DARA WHEELER, Chief

Division of Research, Innovation and System Information

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DRISI staff and management whose support has been essential for the development and implementation of Caltrans research and deployment program.

Preface

Caltrans DRISI manages a comprehensive research portfolio to address research and operational needs across Caltrans. DRISI, in cooperation with our partners, provides solutions and knowledge that helps realize the Caltrans vision of attaining a brighter future for all through a world-class transportation network.

This research manual provides researchers, Caltrans staff, academic partners, and others interested in the research program with the information needed to develop, select, fund, perform, manage, deploy, and implement research that benefits the people of California. This research manual also fulfills the United States Department of Transportation (US DOT) requirements to ensure the relevancy of Caltrans research in meeting national research goals.

An electronic copy of the Caltrans Research Manual is available online at: https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/research-manual-a11y.pdf

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Section 1 Caltrans Research Program Overview

1.1 The Division of Research, Innovation and System Information

To support Caltrans mission, vision and goals, DRISI manages a comprehensive program to research, develop, test, evaluate, and support the deployment and implementation of transportation innovations as requested by its customers.

DRISI seeks to take full advantage of strategic opportunities by identifying public and private partnering solutions. These partnerships leverage the dollars invested in present and future public infrastructure.

1.1.1 Caltrans Vision, Mission, Values, and Goals

Caltrans Vision

A brighter future for all through a world-class transportation network

Caltrans Mission

Provide a safe and reliable transportation network that serves all people and respects the environment

Caltrans strives to be the highest performing transportation agency in the country. In pursuit of our mission, we continue to build a talented and diverse team, and we strengthen ties with our partners. To keep California moving, we commit ourselves to the following values and goals:

Caltrans Values

Engagement

We inspire and motivate one another through effective communication, collaboration, teamwork, and partnership actions.

Equity

We strive to eliminate disparities while improving outcomes for all.

Innovation

We are empowered to seek creative solutions and take informed risks.

Integrity

We promote trust and accountability through our consistent and ethical actions.

Pride

As one Caltrans family, we are proud of our work and strive for excellence in public service.

Caltrans Goals

Safety First

Identify and implement new technologies, innovations, and best practices. These pursuits are both ambitious and urgent, and their accomplishment involves a focused departure from the status quo to the Safe System approach as we continue to institutionalize safety in all our work.

Cultivate Excellence

Attract and develop diverse talent with an emphasis on fostering a welcoming and engaging work environment where innovation is encouraged, and employees receive the guidance and support necessary to achieve their potential. A focused effort on the work environment will lead to an engaged workforce who consider Caltrans a great place to work and grow in their career.

Enhance and Connect the Multimodal Transportation Network

Modernize and integrate transportation services and improve connections between various modes of travel and to

develop a more seamless multimodal system and create greater access for historically underserved communities. All with the goal of improving the experience of those who use the system.

Strengthen Stewardship and Drive Efficiency
Engage our communities to create more equitable outcomes to improve our efficiency and performance. The effective and socially equitable delivery of projects and services ensures that Caltrans continues to be good stewards and managers of California's transportation system for all Californians.

Lead Climate Action
Reduce the environmental impact of our transportation system by not only reducing greenhouse gas emissions from our operations and use of our system but also strengthening the resiliency of the transportation system to withstand and recover from the worsening effects of climate change.

Advance Equity and Livability in all Communities
Adopt many new approaches focused on collaborative community and partner engagement, on measuring impacts to public health and community vibrancy, and on prioritization of investment in historically harmed and segmented communities.

For more detailed information on Caltrans Mission, Vision, Goals and Values see Caltrans Strategic Plan

1.1.2 Strategic Approach to Research

The Executive Board directed DRISI to develop a methodology to evaluate research requests based on how well they align with the Caltrans SP.

The methodology evaluates research against the six SP goals as well as other criteria. The evaluation results in a score indicating the intensity of the strategic alignment. Scores are compiled and funding priority is given to the highest scoring research.

With direction from the Caltrans Executive Board, DRISI:

- Establishes and facilitates the process to identify, select, program, manage, deploy, and support the implementation of research.
- Meets all federal-aid program requirements, including the preparation and maintenance of this research manual and the State Planning and Research (SP&R) Part II Annual Work Program (AWP).
- Establishes the research portfolio based on the ownership and participation of its customers.
- Proactively identifies and supports the implementation of new technologies, innovations, and best practices.
- Supports the implementation of research products.
- Develops and performs applied transportation research for all modes of transportation.
- Provides technical assistance to its customers to implement transportation research products.
- Engages in both short-term and long-term research.
- Allocates funding for the research that includes leveraging national research funding from other transportation organizations and pooled funding opportunities.

The DRISI SP focuses on the alignment of DRISI staff and resources to Caltrans SP and the Planning and Modal Strategic Direction. A copy of DRISI's SP can be found at: DRISI Strategic Plan

1.2 Legal Authority for Research

1.2.1 Federal Laws

The federal law, "Fixing America's Surface Transportation Act or FAST Act, was signed into law on December 4, 2015. It outlines federal priorities for transportation research and authorizes funding for transportation research in the SP&R Parts I and II.

1.2.2 Federal Regulations

The authority for a state research organization to use federal funds is set forth in USC Title 23-Highways, Chapter 5 Research and Technology, Section 505. The authority for a state to administer SP&R funds, Parts I and II, is set forth in the Code of Federal Regulations, (CFR), Title 23, Part 420, Planning and Research Program Administration – 420.117 2(e).

1.2.3 State Laws

The authority for Caltrans to perform research is set forth in California Government Code, Title 2, Division 3, Part 5, Chapter 4, Section 14452, which can be found at: California Government Code 14452

Section 2 Research Program Participation

Introduction

Caltrans has a process to identify research needs, conduct research, and deploy research that includes input from committees representing all functional areas of Caltrans and all levels of staff ranging from technical experts to executive management. See Caltrans Deputy Directive 81-R1 titled Research Program.

2.1 Caltrans Executive Board

The Caltrans Executive Board provides strategic direction and identifies department-level priorities. The Executive Board draws on DRISI as a resource for options such as preliminary investigations, workshops, national programs, specialized transportation related conferences, and academic guidance.

2.2 Research Committees and Panels

DRISI research is customer based. DRISI's research process requires customer participation along with effective deployment through customer ownership of the deployed research products.

Research committees are an important way of involving the customers in the research selection, project management, and implementation process. The research committees and panels are described briefly below.

Further information of research committee and panel membership and their respective functions can be found at: DRISI Research Committees.

2.2.1 Research and Deployment Advisory Committee

The Research and Deployment Advisory Committee (RDAC) advises DRISI on potential research objectives and priorities, recommends an annual program of research projects, and actively sponsors research products that are ready for implementation.

2.2.2 Program Steering Committees

The Program Steering Committees (PSC) are representatives from various Caltrans programs requesting research. PSCs identify program-level research priorities, annually approve multi-year research roadmaps, and support implementation of research products.

An example of a Research Roadmap can be found at: PSC Research Roadmaps

2.2.3 Technical Advisory Panels

The Technical Advisory Panels (TAP) are composed of technical experts from Caltrans divisions, districts, DRISI, and external partners. They recommend research priorities and new research needs to the PSC and identify implementation opportunities.

The PSC, TAP, and DRISI relationship is shown in the PSC/TAP matrix, which can be found at: PSCs-TAPs Matrix.

2.3 Research Program Development Responsibilities

In support of the research program development, DRISI updates their SP, and coordinates the selection process of the annual program of projects.

Some of the research program development responsibilities include:

- Providing staff support to the RDAC
- Advising the PSCs and TAPs
- Preparing the annual program of projects
- Managing the contingency approval process
- Soliciting research proposals
- Coordinating Caltrans -funded research activities with the University Transportation Centers (UTC)
- Coordinating with national transportation organizations such as Transportation Research Board (TRB) and American Association of State Highway and Transportation Officials (AASHTO)
- Leveraging partnered-research activities through Transportation Pooled Fund (TPF) program

Section 3 Research Program Funding

Introduction

The research program is funded by state and federal funds, reimbursed work, and grant funds.

3.1 Funding Types

3.1.1 State Funds

The principal source of state funding for Caltrans research is the State Highway Account (SHA). The state budget act authorizes the SHA, which is a transportation funding source generated from the state tax on motor vehicle fuels.

3.1.2 Federal Funds

The Federal Highway Administration (FHWA) SP&R Part II is the main federal funding source for Caltrans research. SP&R Part II is regulated by Title 23, CFR, Part 420, which identifies the administrative requirements that apply to the use of FHWA planning and research funds.

3.1.3 Reimbursed Work

Research projects are sometimes reimbursed through the request of a partner agency. Normally, this work is performed in conjunction with a state project or activity for the mutual benefit of the State and the partner agency.

3.1.4 Grant Funds

The FHWA, Federal Transit Administration (FTA), or other federal agency acting as research contracting parties, may negotiate with Caltrans (as the contractor) to conduct research through grant processes. Agreements of this kind typically provide 50 percent to 100 percent federal reimbursement of Caltrans costs.

3.2 State Planning and Research, Part II Annual Work Program

In order for the research program to expend federal funds, FHWA approval is required through the SP&R Part II AWP.

3.2.1 SP&R Overview

USC Title 23 Highways, Chapter 5 Research and Technology, provides for SP&R funding. Two percent of the total funds apportioned to the states each year, including California, are designated for planning and research activities.

Of this amount, not less than 25 percent must be spent on research, development, and technology transfer activities relating to highway, public transportation, and intermodal transportation systems.

Federal funds typically provide for 80 percent of the cost of the research projects in the SP&R Part II AWP, and state funds provide for the remaining 20 percent. FHWA has the ability to waive the state match if the interests of the Federal aid highway programs are met by Title 23 CFR 420.119(d).

3.2.2 Caltrans SP&R, Part II AWP

DRISI reports to FHWA on the research projects and administrative costs that will be funded using the SP&R Part II AWP, as required by Title 23, CFR Section 420.111.

The SP&R Part II AWP is developed and approved before the beginning of each new state Fiscal Year. It describes the research work to be performed and estimated costs for that year.

Modifications to the SP&R Part II AWP may occur as a result of project scope and/or funding level changes. These

modifications are transmitted to FHWA through amendments.

3.2.3 AWP Approval

The SP&R Part II AWP is submitted to the local FHWA Division Administrator for review and approval. No work shall begin prior to having approval by FHWA.

3.3 Additional Research Resources

3.3.1 Transportation Pooled Fund Program

When significant or widespread interest is shown in solving transportation-related problems, research and technology transfer activities may be jointly funded by several federal, state, regional, and/or local transportation agencies, academic institutions, foundations, or private firms as a TPF study.

Additional information on the TPF Program can be found at: http://www.pooledfund.org.

3.3.2 National Cooperative Highway Research Program

Caltrans utilizes the National Cooperative Highway Research Programs (NCHRP) to leverage its financial and staff resources.

NCHRP is administered by the TRB and sponsored by the member departments (i.e., individual state departments of transportation) of AASHTO in cooperation with FHWA.

NCHRP was created in 1962 to conduct research in acute problem areas that affect highway planning, design, construction, operation, and maintenance nationwide.

Each state's allocation amounts to five and one half percent of its total SP&R apportionment and is set forth in supplementary tables issued with each year's Federal-Aid Highway apportionments.

Additional NCHRP information can be found at: http://www.trb.org/NCHRP.

3.3.3 Transit Cooperative Research Program

The Transit Cooperative Research Program (TCRP) was established under FTA sponsorship in July 1992.

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands.

Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The TCRP serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

Additional TCRP information can be found at: http://www.trb.org/TCRP.

3.3.4 Airport Cooperative Research Program

The Airport Cooperative Research Program (ACRP) was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act.

The ACRP is sponsored by the Federal Aviation Administration and managed by the National Academies, acting through TRB, with program oversight and governance provided by

representatives of airport operating agencies.

ACRP is an industry-driven, applied research program that develops near-term, practical solutions to problems faced by airport operators.

Additional ACRP information can be found at: http://www.trb.org/ACRP.

3.3.5 University Transportation Centers

The UTCs are nationally-designated centers of excellence, fully integrated within institutions that serve as a vital source of leaders who are prepared to meet the nation's need for safe, efficient, and environmentally sound movement of people and goods.

The UTCs mission is to advance United States (U.S.) knowledge, technology, and expertise in the many disciplines through the mechanisms of education, research, and technology transfer.

In addition to implementable research outcomes such as new analysis tools, survey data and assessment of emerging policy areas, the UTCs provide a critical transportation knowledge base addressing vital workforce needs for the next generation of transportation leaders at university-based centers of excellence.

Information on California research centers currently designated as a UTC can be found at: California University Transportation Centers.

3.4 Peer Exchange of the Research Program

Peer exchanges, as required under 23 CFR, Section 420.207(b), are a practical and effective tool to foster excellence in Research and Technology (R&T) program management. Peer exchanges provide an opportunity for participants to share best practices and management innovations through an open exchange of ideas, knowledge, and brainstorming.

A peer exchange is an information exchange among transportation research colleagues through which a host state may find the means to restructure or fine tune research program processes.

Both staff and management from the host state and a group of invited top-level state and federal managers exchange information particularly relevant to the host state's R&T program over two to four days.

With periodic peer exchanges, a State's DOT helps ensure that its research program remains viable, vibrant, and productive. When invited, Caltrans also participates in peer exchanges for other states and the FHWA.

3.5 FHWA Review of the Research Program

FHWA reviews all state programs for effectiveness and compliance with Federal-aid requirements for continued state certification. FHWA also ensures compliance with all federal laws, regulations, and policies.

Caltrans cooperates with the FHWA to ensure that these research program criteria meet the requirements under CFR, Title 23, Part 420, for the administration of planning and research funds.

Section 4 Research Project Development

Introduction

DRISI provides research solutions to California's transportation problems through its research projects. These research solutions are composed of deployable products that can be implemented by Caltrans or other public agencies. Each research problem, project, and solution are sponsored and supported by a Caltrans Division and/or District.

4.1 Project Definition

A research project typically results in a deployable product, as defined in Section 5.1.3 however, some research may need to be broken up into logical partitions to create the deployable product, and offer an opportunity for the PSC to reassess the progress of the research at regular intervals.

4.2 Project Selection Process

The research selection process is composed of annual and contingency components.

4.2.1 Annual Research Cycle

Research funding requests are reviewed, prioritized, and approved both individually and by functional programs during the annual research selection cycle.

The annual research cycle provides an opportunity to reassess the strategic alignment of ongoing and planned research. Additional information on DRISI's Annual Funding Request Process can be found in Appendix C.

4.2.2 Contingency Approval Process

The contingency process provides an opportunity to consider research requests that are outside of the annual research selection cycle.

Additional information on DRISI's Contingency Funding Request Process can be found in Appendix D.

4.3 Project Preparation

4.3.1 Preliminary Investigations

Prior to initiating a research project, a Research Preliminary Investigation (PI) may be performed. A PI is a literature review and identification of best practices in a specific field and function of the transportation system. The PI provides a comprehensive overview of historical and ongoing national and international work on a potential research problem.

Findings of a PI will indicate whether: a solution is available, relevant research is in progress that can be built upon, or new research is required. When new or additional research is needed, a research project is created.

The PI Request Form, PI Process Diagram, and completed PIs can be found at: DRISI Preliminary Investigations.

4.3.2 Project Manager and Panel Roles

All research projects have a Project Panel. The role of the Project Panel is to guide the research project. The membership of the Project Panel is flexible and varies by the size and complexity of the project. At a minimum, the Project Panel consists of the research Project Manager (PM), the

Researcher, and the customer representative.

If a project involves several functional areas or requires special expertise, the Project Panel should also include other experts to guide the project during the research activities. The Project Panel may have representation from academia, industry, non-government organizations, and local, state, and federal government. The research PM is the chair of the Project Panel and appoints all panel members, in consultation with the customer representative.

Activities

Project Panel activities may include:

- Helps review research proposals for potential projects
- Develops the scope of work for each project
- Facilitates the resolution of problems or delays
- Makes recommendations to the PM regarding project scope, budget, time modifications, and continuation of studies
- Reviews the draft and final reports
- Recommends an implementation plan for research (see section 7.2.2)

Section 5 Research Project Management

5.1 Project Management

The purpose of project management in DRISI is to achieve the objectives of a research project on schedule and within budget. The project management process starts before any resources are committed and continues until all work is finished.

The PM is a Caltrans employee with full authority and responsibilityto manage all aspects of an approved project. The PM is responsible for delivering the product within budget, on schedule, and to the satisfaction of the project's sponsors, customers, and end users.

5.1.1 Project Execution

There are three mechanisms used to conduct a DRISI research project. These are:

- Contract Research
- In-House Research
- TPF Research

Each method has its own execution criteria, see Sections 5.2, 5.3, and 5.4 respectively. All DRISI research projects (Contract Research, In-House Research, and TPF Research) are required to follow the project management requirements of Section 5.1.

5.1.2 Changing a Project

The need for a change in a research project can happen at any time after the project's initiation.

A research project may need to be changed due to new information being discovered, modifications in funding possibilities, or modifications in research priorities.

The steps to change a research project scope include:

- A recommendation from the Project Panel
- Approval from the related PSC
- Make any necessary changes to the contract

Resource approval may also be necessary if additional time or funding is needed.

5.1.3 Project Reporting

Quarterly Progress Reports

Quarterly progress reports for all active projects are required throughout the life of the project. For contracted research the contractor is required to submit quarterly progress reports to the PM. The PM updates the Research Project Management Database (RPMD).

Research Notes

For each current research project, a two-page research notes brief is written for the general audience to provide an understanding of the project quickly and concisely. Each research notes contain the project's purpose, description, and the progress of the research. DRISI's research notes documents can be found at: DRISI Research Notes

Research Results

At the end of each research project, a two-page brief is created to summarize the results of the research project. The customer focused research projects may result in deployable products and solutions that can be implemented by Caltrans and its partners.

Potential deployable products are:

- New or improved technical standard, plan, or specification
- New or improved manual, handbook, guidelines, or training
- New or improved policy, rule, or regulation
- New or improved business practice, procedure, or process
- New or improved materials or equipment
- New or improved decision support tool, simulation, model, or algorithm (software)
- Processed data/database and collection
- Evaluation of new commercial products to determine if they meet Caltrans needs

To see DRISI's research results documents go to: DRISI Research Results

Final Reports

A final report is created at the conclusion of each research project. The reports are distributed to the State, federal, and National Depository Libraries and can be found at: DRISI Research Final Reports.

5.1.4 Project Closing

Terminating a Research Project

Terminating or canceling a research project goes through the same steps as changing a research project.

Project Close-out

When a project is completed, the PM will close the project in accordance with the research project close-out process and procedures. The close-out process can be found at: DRISI Research Closing Process.

5.2 Management of Research Contracts

5.2.1 Research Contract Types

The research contract allows Caltrans to utilize the expertise of universities and other transportation consultants.

The research contract is also the mechanism used to encumber multi-year funding. This allows DRISI to provide better fiscal management of the research program.

The PM is responsible for adhering to Caltrans Contract Manager's Handbook. The various types of research contracts are:

- Standard Agreements
- Interagency Agreements
- Master Interagency Agreements
  - Research Technical Agreements
  - Task Orders
- Leverage Procurement Agreements
  - California Multiple Award Schedules (CMAS)
  - Cooperative Agreements
  - Master Service Agreements
  - Statewide Contracts*
  - State Price Schedule*

**Used primarily for purchase orders*

5.2.2 Executing Research Contracts

DRISI submits research contracts for approval in accordance with the Caltrans contracting procedures found in the State Contracting Manual. The PM prepares all the documents necessary to execute each type of research contract.

5.2.3 Managing Contracts

Research contract management responsibilities extend from contract development to contract completion.

All Caltrans PMs receive formal contract management training and must comply with the requirements in the Caltrans Contract Manager's Handbook. For Caltrans staff the handbook is available here.

5.3 Management of In-house Research

Introduction

In-house research differs from contracted research in that the researcher is an employee of Caltrans. The in-house researcher often also serves as the PM

5.3.1 Value of In-house Research

In-house research enables Caltrans to:

- Give transportation administrators and managers accurate and substantive advice quickly, during emergencies or where problems being researched have safety implications
- Assess emerging research results and determine appropriate solutions to benefit California transportation programs
- Evaluate field-implemented transportation innovations for cost saving implications

5.3.2 Requirements for In-house Research

Approval by DRISI management is required prior to starting in-house research.

In house researchers should possess the following:

- Expertise in the subject area of the research and the techniques to be used in the proposed research project
- Ability to dedicate the required amount of time to the research during the life of the project
- Ability to serve as the liaison with the committees and panels identified in this research manual

5.3.3 Execution and Management of In-house Research

The in-house researcher utilizes the NCHRP Report 20-45 "Scientific Approaches to Transportation Research", NCHRP Report 727 "Effective Experiment Design and Data Analysis in Transportation Research", and DRISI's In-house Research Criteria at: DRISI In-house Research Criteria.

5.4 Management of Transportation Pooled Fund Research

Introduction to TPF Research

The TPF Program allows federal, State and local agencies, and other organizations to combine resources to support transportation research studies.

The TPF Program is a popular means for State DOT's, commercial entities, and FHWA program offices to combine resources and achieve common research goals.

Pooling resources reduces costs and provides efficient use of taxpayer dollars. It also provides greater benefits to participating interests as compared to individual entities conducting or contracting research on their own.

5.4.1 Involvement in Transportation Pooled Fund Research

When significant or widespread interest is shown in solving transportation-related problems, research, planning, and technology transfer activities may be jointly funded by federal, state, regional, and/or local transportation agencies, academic institutions, foundations, or private firms as a pooled fund study.

A federal or state transportation agency may initiate pooled fund studies. Regional and local transportation agencies, private companies, foundations, and colleges/universities may participate in pooled fund projects. TPF studies must be sponsored by either a State DOT or the FHWA.

Additional information on transportation pooled fund program for Caltrans staff can be found on the DRISI research page at https://drisi.onramp.dot.ca.gov/drisi-research-program.

General information on Pooled Fund Projects is on the TPF website at: http://www.pooledfund.org.

Section 6 Research Evaluation

Introduction

DRISI uses performance management and research project evaluation to more efficiently manage the research program and determine the program's overall effectiveness.

6.1 Research Program Evaluation

Performance management is a tool for diagnosing, solving problems, and maximizing opportunities. Performance management provides a framework that enables the DRISI research program to set realistic goals, focus on the most important challenges, and improve efficiency.

Performance management at DRISI is the ongoing process of establishing goals, selecting performance measures, evaluating the results, and closing the circle by reviewing and refining performance measures. The DRISI management team uses these evaluation tools to effectively manage the research program.

6.2 Research Project Evaluation

Every research project will be subject to evaluation. The two major areas of the DRISI research project evaluation are continuing project evaluation and final project evaluation.

6.2.1 Continuing Project Evaluation

Continuous project oversight occurs throughout the life of every DRISI project and is formally performed quarterly with a project review occurring annually.

The purpose is to ensure that a project is achieving its stated objectives by remaining within scope, on schedule, within budget, and to the satisfaction of the Project Panel and customers.

Quarterly Project Review

A basic mechanism for the quarterly evaluation is the project quarterly report. The PM is responsible for conducting the project quarterly evaluation and posting the results in the RPMD. For further details see DRISI's web link at:
DRISI Quarterly Reporting Guidelines.

The PM is responsible for reviewing the information posted in the quarterly report(s), evaluating the project as a whole, and communicating the results to DRISI management and to the project customers.

The PM's three basic recommendations to management are:

- Continue with the project as it stands
- Make changes in the project scope, schedule, or funding
- End of the project

Annual Review

Annually each PSC will review their portfolio of projects and determine if each project should be continued, modified, or canceled. The Project criteria used for this effort will include:

- Financial performance as determined through the performance measures
- Success to-date in meeting the objectives according to the schedule as determined through the performance measures
- Potential for ultimately meeting the project objectives within scope, on schedule, and within the budget
- Potential risks impacting implementation

- Alignment of the project with the goals and priorities of Caltrans
- Availability of continued project funding

The results of the PSC annual review will be utilized (along with other information) by the RDAC in preparing the Strategic Research Plan and Annual Program of Research Projects.

Review at Project Completion

When each project is completed, there will be a formal review of the entire project to determine if the identified research need has been satisfied or if further research is needed.

The PM and the Project Panel will conduct the review and make recommendations to the appropriate PSC and DRISI management about future research. The PSC and DRISI management will make the determination, taking into consideration the recommendations of the PM and the Project Panel.

The criteria used to determine future research includes, but is not limited to:

- Success in meeting the objectives of the completed project
- Successful delivery of all the scheduled deliverables of the completed project
- The project was on-budget or under-budget as of the date of the review
- The PM and the Project Panel's assessment of risks for the future research project and their determination that there is a high probability for successful project completion
- Adequate funding exists
- The project continues to have a high priority for the PSC and for Caltrans
- Deployment and implementation potential

6.2.2 Final Project Evaluation

Completed Research Projects

Final evaluations are performed by the PM at the conclusion of each project. The PM will use the following questions to determine the lessons learned and success of the project:

- Did the objectives of the project meet the satisfaction of the customer and other stakeholders?
- Did the project produce all the expected products?
- Have the customers formally verified and accepted the products produced during the research?
- Did the products meet all functional, performance, and quality specifications?
- Was the final research report written and accepted by Caltrans?
- Has the final research report been distributed to appropriate depositories and stakeholders?
- Were the research methodologies used appropriate for the subject area?
- Was the project completed within the approved schedule?
- Was the project completed within the approved budget?
- If appropriate, are the research results in the process of being published in a peer reviewed journal?
- Are the anticipated benefits of the research being realized?
- Is the product being implemented by Caltrans, or by others?

The PM isencouraged to use quantitative analyses, such as cost reduction or crash reduction when appropriate, to evaluate the success of a completed project.

As part of the evaluation, the PM will recommend to DRISI management and the appropriate PSC if further research is needed.

Canceled Research Projects

Research projects may be canceled as noted in the Section 5.1.4 Project Closing. Every canceled project will still be evaluated by the PM as part of the project closing process. The PM will review the project and recommend to the PSC and DRISI management whether or not to continue work in the research area with a new modified project.

Section 7 Research Implementation

Introduction

DRISI places emphasis on applied research as the means of developing innovations that can solve the problems facing the transportation infrastructure owners, operators, and users.

DRISI research also addresses transportation trends and policies that are driven by increasing demands, limited resources, and greater stakeholder expectations. Research results are most effective when completely implemented in the intended transportation environment.

Towards that goal, a well-developed research implementation strategy is needed.

7.1 Implementation Roles

DRISI Research Implementation Responsibilities

The PM, together with the Project Panel, the researchers, the customers, and the sponsors, guide the development of research products throughout the research process so it may eventually be implemented.

7.1.1 Implementation Engineer

- Maintains implementation guidance
- Works with the project manager, customer representative, researcher, the Project Panel and DRISI to determine if a research implementation plan is needed. The implementation plan provides the means for the customer. to identify and document the necessary resources, processes, and requirements that will be needed to implement the product of the research
- Facilitates the annual process of customers seeking implementation assistance through seed money. The seed money is used for prototype equipment, training, expert time, etc.

7.1.2 Implementation Project Manager

The Project Manager noted in Section 5:

- Works with the implementation engineer, customer representative, researcher, the Project Panel and DRISI to determine if an implementation plan is needed
- Checks with the customer at least biannual for the first year
- Assist with the Implementation Plan as needed

7.1.3 Researcher

The researcher plays an important role in the preparation of information, materials, and mechanisms needed to implement the research findings.

The researcher works with the PM to develop suitable mechanisms for implementation, and participates in technology transfer activities. Examples include presentations and training classes. The researcher may also participate in the development of marketing brochures, user manuals or other mechanisms appropriate for the implementation of the research results by the customers.

7.1.4 Customer Representative

The customer, typically a Caltrans Division or District, engages in the project throughout the research process. Customer participation is

critical since the customer needs to assure that resources will be available to implement the research results which can be a new policy, practice, product, or service. If implementation seed money is needed, customer will apply for DRISI assistance.

7.2 Implementation Approach

The DRISI implementation approach is based on a customer involvement and ownership from the beginning as the research moves through its progressive phases over time and it leads to the final product.

7.2.1 Implementation

Implementation describes the various activities that are required to put the product of a research project into widespread use.

In the context of the DRISI research development process, implementation is the adoption of research products.

7.2.2 Implementation Plans

Implementation Plans are the documents that will be used to guide DRISI research towards the implementation of the research products.

Implementation Plans help the PM and the Project Panel to identify the expected outcome and to develop a clear implementation strategy at the outset of the research process.

The scope, content and extent of the Implementation Plan is dependent upon several factors, including complexity of research, costs, risks, uniqueness, etc. For simpler projects, the Implementation Plan may be a few pages, whereas for more complex projects, it will be more detailed.

7.2.3 Technology Transfer

Technology Transfer is the process by which research knowledge is communicated or shared by Caltrans.

Technology Transfer includes those activities that lead to the adoption of a new technique or product and can involve implementation, dissemination, demonstration, and training.

Appendix

Appendix A: Initialisms and Acronyms

AASHTO .....American Association of State Highway and Transportation Officials

ACRP.....Airport Cooperative Research Program

AWP .....Annual Work Program

Caltrans .....California Department of Transportation

CFR.....Code of Federal Regulations

CMAS.....California Multiple Award Schedules

DOT .....Department of Transportation

DRISI .....Division of Research, Innovation, and System Information

FAST Act.....Fixing America's Surface Transportation Act

FHWA .....Federal Highway Administration

FTA.....Federal Transit Administration

NCHRP .....National Cooperative Highway Research Program

PI.....Preliminary Investigation

PM .....Project Manager

PSC.....Program Steering Committee

R&T .....Research and Technology

RDAC .....Research and Deployment Advisory Committee

RPMD .....Research Project Management Database

SHA.....State Highway Account

SP.....Strategic Plan

SP&R.....State Planning and Research

TAP .....Technical Advisory Panel

TCRP.....Transit Cooperative Research Program

Appendix A: Initialisms and Acronyms, page 2

TPF .....Transportation Pooled Fund

TRB.....Transportation Research Board

US .....United States

USC .....United States Code

US DOT.....United States Department of Transportation

UTC.....University Transportation Center

Appendix B: Definitions

Customer: The customer typically a Caltrans Division or District, engages in the project throughout the research process. Customers may be the end-user, a sponsor or a champion on behalf of another public entity.

Deployable Product: A deployable product is a research solution that can be implemented by Caltrans and its partners.

Implementation: The various activities that are required to put the product of a research project into widespread use. Implementation mainstreams a technology or innovation into an organization's standard operating procedure.

In the context of the DRISI research development process, implementation is the adoption of research products within the California transportation system infrastructure.

Implementation Plan: Implementation Plans are the documents that will be used to guide DRISI research towards the implementation of the research products.

In-house Research: In-house research differs from contracted research in that the researcher is an employee of Caltrans. The in-house researcher often also serves as the PM.

Peer Exchange: (Also known as Peer Review), an information exchange among transportation research colleagues through which a host State may find the means to restructure or merely fine tune research program processes.

Performance Management: Performance management is a tool for diagnosing, solving problems, and maximizing opportunities. At DRISI performance management is the ongoing process of establishing goals, selecting performance measures, evaluating the results, and closing the circle by reviewing and refining performance measures

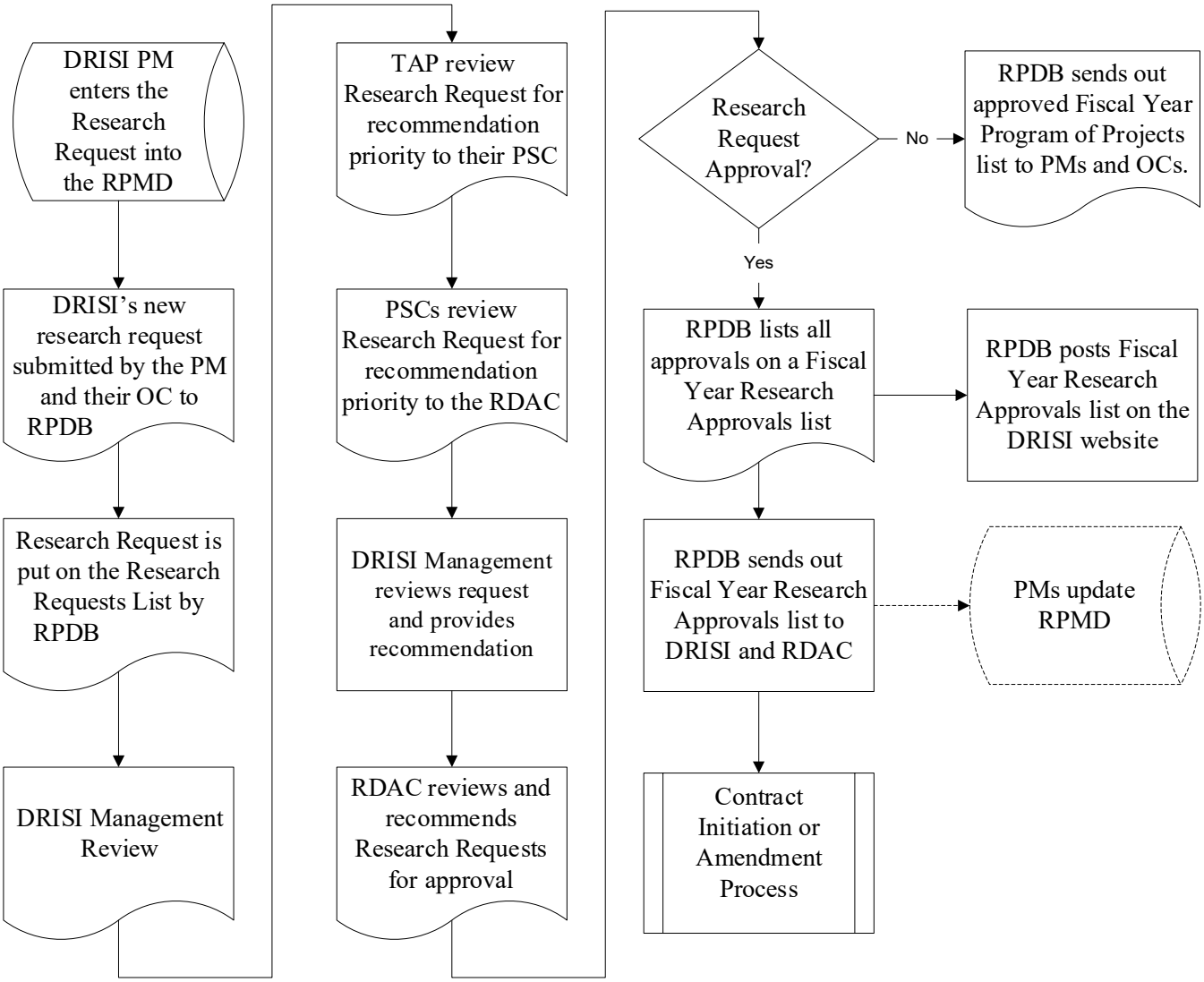
Performance Measures: DRISI measures products outcome, efficiency, and stakeholder satisfaction types for its performance management.

Preliminary Investigation: A Research Preliminary Investigation is a literature review and identification of best practices in a specific field and function of the transportation system.

Appendix B: Definitions, page 2

Program Steering Committees:	PSCs are representatives from various Caltrans programs requesting research. PSCs identify program-level research priorities, annually approve multi-year research roadmaps, and support implementation of research products.
Project:	A research project typically consists of a sequence of tasks that results in deployable products are research solutions that can be implemented by Caltrans and its partners.
Project Panel:	The Project Panel is flexible and varies by the size and complexity of the project. At a minimum, the Project Panel consists of the research Project Manager and the customer representative. The Project Panels purpose is to guide the research project.
Research Project Management Database:	The RPMD is a database used to store, manage, and report on the research program and projects.
Technical Advisory Panels:	The TAP is composed of technical experts from Caltrans divisions, districts, DRISI and external partners. They recommend research priorities and research needs to the PSC and identify implementation opportunities.
Technology Transfer:	Technology transfer is the process by which research knowledge is communicated or shared by Caltrans. Technology Transfer includes those activities that lead to the adoption of a new technique or product and can involve information dissemination, demonstration, and training.

Appendix C: DRISI Annual Funding Request Process
(Referenced from page 9)



ACRONYMS
DRISI: Division of Research, Innovation and System Information
RPMD: Research Project Management Database
PM: Project Manager
OC: Office Chief
RPDB: Research Program Development Branch
TAP: Technical Advisory Panel
PSC: Program Steering Committee
RDAC: Research and Deployment Advisory Committee

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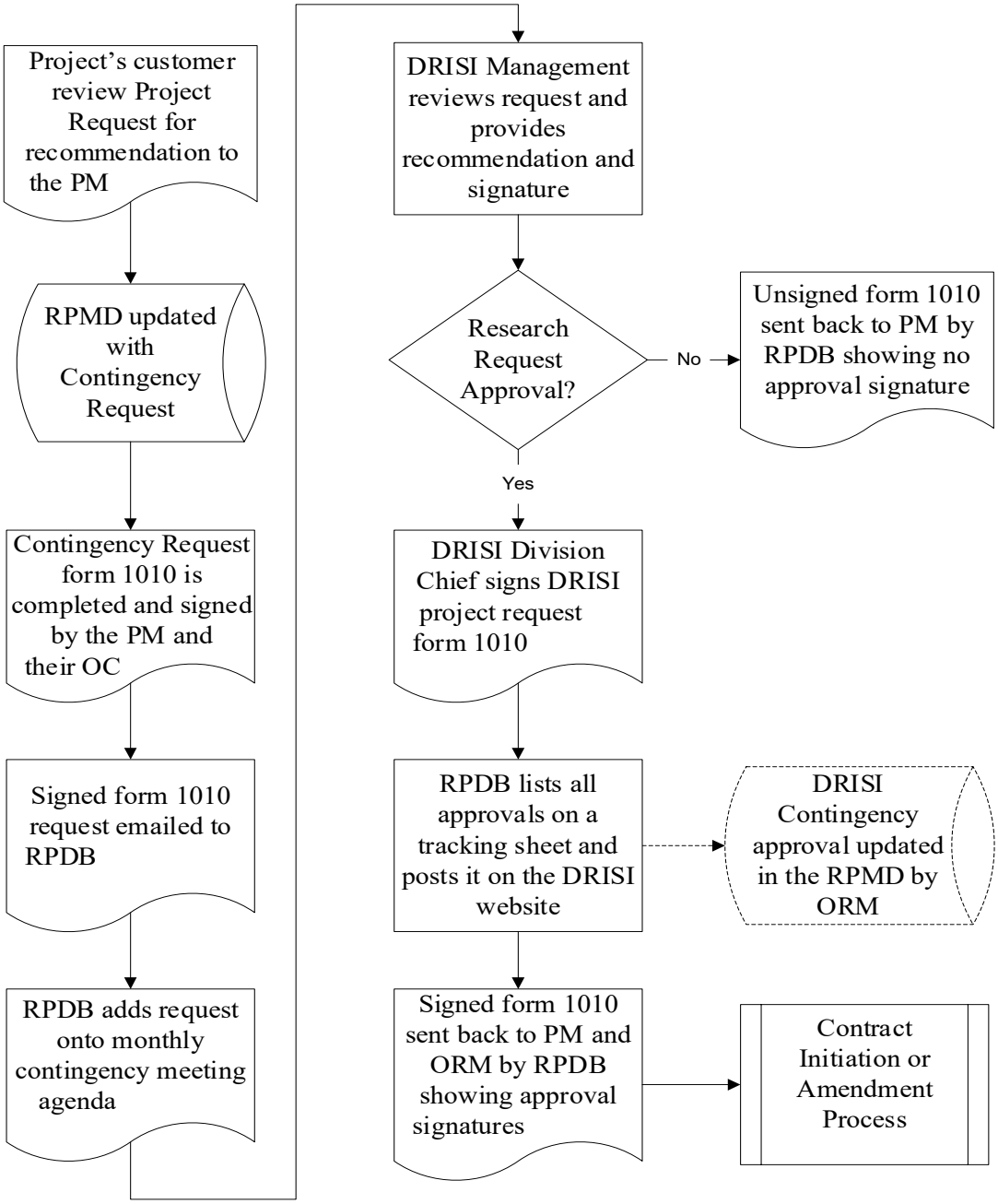
Appendix D: DRISI Contingency Funding Request Process
(Referenced from page 9)



ACRONYMS
DRISI: Division of Research, Innovation and System Information
RPMD: Research Project Management Database
PM: Project Manager
OC: Office Chief
RPDB: Research Project Development Branch
ORM: Operations and Resources Management

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Appendix E: DRISI Website Links

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DRISI Research Notes	11	Sub-section 5.1.3
DRISI Research Results	12	Sub-section 5.1.3
DRISI Research Final Reports	12	Sub-section 5.1.3
DRISI Research Closing Process	12	Sub-section 5.1.4
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DRISI Transportation Pooled Fund Information	14	Sub-section 5.4.1
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